UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
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AOM 6402

STUDENT OUTLINE

MAINTAIN HMMWVA2 ENGINE LUBRICATION SYSTEM

LEARNING OBJECTIVES:

1. Terminal Learning Objective: Given TM 9-2320-280-20-1&2, and partial statements, complete the statements to describe the procedures followed to perform organizational maintenance on HMMWVA2 engine lubrication system, per information contained in the references. (6.4.1)

2. Enabling Learning Objectives: Given TM 9-2320-280-20-1&2, and partial statements, per information contained in the references, complete the statements to describe the procedures followed to:

a. inspect the engine lubrication system, (6.4.1a)

b. test the CDR valve, and (6.4.1b)

c. diagnose the cause of malfunctions in the oil pressure indicating system. (6.4.1c)

OUTLINE

1. INTRODUCTION TO THE HMMWVA2 ENGINE LUBRICATION SYSTEM

a. The engine lubrication system lubricates engine components, filters out oil contaminants and cools the engine oil.

(1) The oil pan serves as a reservoir for the engine oil supply; its capacity is approximately 8 quarts with a filter. The oil pan is located on bottom of the engine and also includes an oil drain plug.

(2) The oil filter, filters impurities from the engine oil and is located on the left lower rear of the engine.

(3) An oil pump, located internal to the engine on the rear main bearing cap, circulates oil throughout the lubrication system.

(4) The oil cooler is located on top of the radiator and is the lower half of the oil cooler assembly. It directs oil through a series of fins and baffles so outside air can remove excess heat from the oil.

(5) The engine oil dipstick is used to physically measure the amount of oil in the oil pan. The dipstick, located on the left side of the engine, has a seal at the top to prevent entry of water during fording.

(6) The oil pressure monitoring system is composed of an oil pressure sending unit mounted on the upper left rear of the engine, an oil pressure indicator gage on the instrument panel, and an interconnecting engine and chassis wiring harnesses.

(7) Crankcase depression regulator (CDR) valve.

(a) Government standards dictate that the emissions from automotive equipment be reduced. To aid in the reduction of these emissions, the HMMWVA2 engine employs a crankcase depression regulator, or CDR valve, to control crankcase gases.

(b) The CDR valve is actually a multipurpose valve.

1 During normal vehicle operation, a diaphragm and spring in the CDR valve respond to intake vacuum to maintain the desired negative pressure or vacuum in the crankcase. Too much pressure in the crankcase will cause leaks and too much vacuum will draw engine oil out of the crankcase and into the intake manifold; both of those conditions are unacceptable. The following describes how the diaphragm and spring, working in conjunction with vacuum created by downward motion of the pistons, controls the flow of crankcase gases out of the crankcase by maintaining the desired vacuum.

a At low engine speed, when there is little vacuum being created in the diesel engine, the spring in the CDR valve pushes the diaphragm away from the outlet tube of the valve creating a large opening at the outlet tube so that crankcase gases can easily escape even though the vacuum drawing them out of the crankcase is low. This condition also controls the pressure that would otherwise develop in the crankcase and prevents crankcase oil from being forced past seals and gaskets resulting in leaks.

b As engine speed increases, downward movement of the pistons creates a vacuum in the intake manifold that is open to the outlet tube of the CDR valve. The vacuum overcomes tension on the spring in the CDR valve and draws the diaphragm close to the top of the outlet tube. At this time, crankcase gases are being drawn from the crankcase and pulled into the intake manifold for reburning.

Action of the diaphragm prevents the full amount of vacuum from being applied to the oil in the crankcase and oil being pulled out of the crankcase and into the intake manifold.

2 The second function that the CDR valve performs relates to fording operations. To prevent water from entering components that are submerged, it is necessary to pressurize those components. On the HMMWV, provisions are made for pressurizing the geared hubs, differentials, transmission, transfer, engine crankcase and the power steering pump. This is how the pressurization is accomplished.

a When the vehicle enters water that covers the pressure sensor cup located on the frame rail on the passenger side opposite the starter, air that is trapped in the line running from the sensor to the top of the CDR valve is pressurized. Pressure is applied to top of the diaphragm in the CDR valve and the diaphragm is forced down until it contacts the top of the valve's outlet tube. This effectively seals the crankcase and allows pressure to build to an acceptable level.

b When the fording valve is placed in the "FORD" position, pressure in the crankcase is routed to various components that require pressurization by tubing through the CDR valve. The desired level of pressure throughout the components is maintained by action of excess pressure on the diaphragm in the CDR valve overcoming pressure from the sensor cup and partially opening the valve's outlet port.

c The unwanted crankcase gases are dumped into the intake manifold each time pressure from the crankcase overcomes pressure from the sensor cup and the CDR valve outlet is opened to the manifold.

d When a vehicle enters your maintenance shop, always check to make sure the fording selector switch is in the vent position. If the switch is placed and left in the ford position, excessive pressure will build in the components that require pressurization during fording operations causing damage to the oil seals.

b. Principles of Operation

(1) A camshaft driven, gear-type oil pump picks up oil from the oil pan and pumps it to the radiator-located oil cooler. If the oil cooler becomes plugged, a bypass valve is automatically activated and oil then flows directly to the oil filter.

(2) Oil flows through the cooler and then is routed to the oil filter.

(3) The oil filter is a cartridge type filter. All oil going to the engine passes through the filter; this type of filter is called a full flow filter.

(4) If the oil filter becomes clogged, a bypass valve automatically shunts oil around the filter.

c. Inspect Lubrication System Components For Serviceability/Leaks

(1) Oil pan.

(a) Inspect for leakage along the rim of the oil pan as well as on the ground directly underneath the engine.

(b) Inspect the mating surfaces for distortion or loose mounting bolts.

(c) Inspect the oil pan for dents and cracks. Replace the oil pan if necessary.

(2) Oil pan drain plug.

(a) During operation, check for leaks and correct sealing of mating surfaces and gasket.

(b) If removed for oil service, inspect the drain plug threads and gasket for damage. The drain plug is magnetic; check for metal filings attracted to the end installed into the oil pan. If metallic pieces are found, notify your supervisor.

(3) Oil filter and adapter.

(a) During operation, check for leakage at the mating surfaces of the oil filter and oil filter adapter.

(b) If the adapter is removed during oil service, inspect all sealing surfaces for distortion or cracks. Always replace the gasket, O-ring seals, and the adapter seals when the unit is removed. Inspect the reducer boss for damaged threads or cracks.

(4) Oil cooler hoses and oil cooler.

(a) During operation, inspect the oil cooler hoses and fittings for security of mounting, leaks, distortion, or damage.

(b) Check all mounting straps and brackets for looseness and damage. Oil cooler supply and return lines are routed along the left side of the engine and supported by attachments to both engine and frame.

(c) If removed for servicing, inspect the hose elbow pipe connector, oil cooler ports, and engine block ports for damaged threads and cracks.

(d) Inspect the oil cooler for rust, cracks, leaks, and security of mounting. Clean debris from cooling fins to ensure adequate air flow.

(e) Clean or replace damaged parts as necessary. Refer to Chapter 2 of TM 9-2320-280-20-2 for cleaning instructions.

(5) Oil dipstick.

(a) Inspect dipstick for damage. Check for legibility of fluid level indicator markings.

(b) Make sure that the dipstick seats properly in the dipstick tube.

(c) Marine Corps vehicles are designed for deep water fording operations. The oil dipstick is equipped with a seal to prevent the entry of water during fording operations. The small T-handle on top of the dipstick is used to compress the rubber seal. When you turn the handle clockwise, the seal expands and contacts the side of the dipstick tube, thus sealing the unit. Inspect the rubber seal to ensure that it is not deteriorated and that it does expand when the T-handle is turned clockwise.

d. Service the HMMWVA2 Engine Lubrication System

(1) Drain oil

(a) Although the oil should be warm prior to draining, do not drain the oil when the engine is hot. Hot engine oil can cause burns.

(b) Have a drainage container ready to catch the oil.

(c) Remove the drain plug and gasket from the oil pan. Allow the oil to drain completely. Remember, the drain plug is equipped with a magnet: it should be inspected for the presence of metal particles.

(d) Install the drain plug and gasket. Tighten the plug to 20 foot-pounds.

(2) Remove oil filter

(a) Have a container ready to catch the oil.

(b) Use an oil filter wrench to unscrew and remove the oil filter from the filter adapter.

(c) Discard the used filter.

(3) Install oil filter

(a) Apply a light coat of oil to the filter gasket before installation.

(b) Install the oil filter on the oil filter adapter and tighten by hand until the gasket contacts the filter adapter. Tighten the oil filter by hand an additional 1/2 - 3/4 of a turn.

(4) Replenish oil

(a) Unscrew and remove the fill cap from the filler tube. Fill with oil according to LI 2320-12/8 and the prevailing temperature. The oil capacity is approximately eight quarts.

(b) Install the filler cap on the filler tube.

(5) Start the engine and inspect for leaks at the oil filter and drain plug

2. TEST, REMOVE, CLEAN, INSPECT, AND INSTALL CDR VALVE

a. Test the CDR Valve

(1) Remove the engine oil dipstick from the dipstick tube.

(2) Install the adapter and manometer in the dipstick tube.

(3) Connect STE/ICE-R unit to DCA connector.

(4) Start and operate the engine at idle speed.

(5) The pressure reading should be zero inches of water or a slight amount of vacuum. Record this reading.

(6) Increase engine speed to 2,000 RPM and record the water pressure.

(7) Pressure reading should be 2 to 5 inches.

(8) If pressure readings are not within specifications, replace the CDR valve.

b. Remove CDR Valve and Hoses. Remember, Marine Corps vehicles are equipped with deep water fording kits; our CDR valves have two additional vent lines.

(1) Loosen the clamp and disconnect the CDR valve hose from the oil fill tube.

(2) Loosen the clamp holding the hose to the CDR valve and remove the hose.

(3) Loosen the clamp and disconnect the CDR valve hose from the intake manifold.

(4) Remove two screws and washers securing the CDR valve to the bracket and remove the CDR valve and CDR valve hose. The rear bolt also secures the heater control cable by way of a clamp secured to the CDR bracket.

(5) Loosen the clamp and remove the hose from the CDR valve.

(6) If the CDR valve is defective, replace it.

c. Inspect and Clean the CDR Valve and Hoses

(1) Inspect the intake manifold hose adapter for cracks or breaks. Replace if defective.

(2) Inspect hoses for cracks, breaks, brittleness, or obstructions.

(3) Clean rubber and plastic components with soap and water.

(4) If the engine is reported to have been smoking excessively during normal operation, the CDR valve may be plugged.

(a) To check the CDR valve, disconnect the CDR valve oil fill tube from the CDR valve. If oil drips out of the CDR valve or hose, replace the CDR valve. The CDR valve should be checked for serviceability during a semiannual PMCS.

(b) If oil was present on the manifold, remove the air horn and clean all traces of oil; also clean the hoses if oil was found there.

d. Install CDR Valve and Hoses

(1) Connect the hose to the CDR valve and secure it with a clamp.

(2) Attach the CDR valve to the bracket and secure it with two washers and screws. Tighten the screws to 15 foot-pounds. Remember to secure the heater control cable clamp with the rear bolt.

(3) Connect the CDR valve hose to the intake manifold and secure it with a clamp.

(4) Connect the CDR valve to oil fill tube hose to the oil fill tube, and secure with a clamp.

(5) Connect the oil fill tube to CDR valve hose to the CDR valve and secure with a clamp.

3. DIAGNOSE MALFUNCTIONS IN THE HMMWVA2 ENGINE LUBRICATION SYSTEM

a. Diagnose Excessive Oil Loss or Consumption

(1) Dark blue smoke coming from the exhaust in conjunction with excessive oil consumption may indicate that the engine is burning oil.

(2) Make sure that the proper grade of oil is being used in the engine.

(3) Inspect the engine for leaks at the following points:

(a) oil pan and oil pan drain plug;

(b) oil filter and adapter;

(c) oil dipstick tube;

(d) oil cooler, oil cooler lines, and fittings;

(e) valve covers; and

(f) oil pressure sensor.

(4) Tighten any loose connections or replace damaged parts.

b. Diagnose Malfunctions in the Oil Pressure Indicating System

(1) Test a malfunctioning oil pressure gage.

(a) Disconnect lead 36A from the oil pressure sending unit located on the left rear of the engine.

(b) Turn the master start switch to the "RUN" position. The oil pressure gage should indicate maximum pressure.

(c) Touch lead 36A to ground. The oil pressure gage should indicate minimum pressure; if so, the oil pressure gage is operating correctly.

(2) Test an inoperative oil pressure indicator wiring circuit.

(a) Disconnect leads 36A, 27H, and 58G from the oil pressure gage.

(b) With master start switch in the "RUN" position, check for battery voltage at lead 27H.

(c) Check for continuity from lead 58G to ground and continuity through lead 36A.

(d) If all leads test correctly, wiring harness is OK, the oil pressure gage is defective.

(e) If any lead does not test correctly, repair the wiring harness.

(3) Test a malfunctioning oil pressure sending unit.

(a) Remove the oil pressure sending unit.

(b) Using a direct reading pressure gage, check the oil pressure. If oil pressure is normal, 30-60 pounds per square inch at idle, replace the oil pressure sending unit.

(c) If STE/ICE-R is available, perform NG05-low oil pressure test. The instructions for accomplishing this task are in Chapter 2 of TM 2320-280-20-2.

(d) If oil pressure is still low, notify your supervisor.

REFERENCES:

TM 9-2320-280-20-1
TM 9-2320-280-20-2